To: California Department of Water Resources, Attn: Lauren Bisnett, Public Affairs Office P.O. Box 942836, Sacramento, California 94236; SGMPS@water.ca.gov

Subject: Draft GSP Emergency Regulations Public Comment

From: Dr. Hugo Loaiciga (UCSB) and Dr. Mark Kram (Groundswell Technologies); 4/1/16

Dear Ms. Bisnett,

We are writing in response to DWR's request for public comment regarding the Draft Groundwater Sustainability Plan (GSP) Emergency Regulations prior to the regulations being adopted. We bring close to 60 years of combined Hydrogeological and Geochemical experience to this subject and as such, greatly appreciated this opportunity to provide our input at this very critical time in our state's history. We intend to focus on several key points we believe can immediately place our state on a trajectory towards sustainable groundwater management using the most pragmatic and technologically advanced methods currently available. We would also greatly appreciate an opportunity to meet with key DWR decision-makers so that we can discuss these items in greater detail, and forge a collaborative relationship that will result in positive outcomes for all parties involved, including the public at-large.

We will begin with stating Key Points, which we will further describe in sections below. These Key Points include the following:

1) It is impossible to manage what is not measured. As such, we are strong advocates for real-time continuous monitoring of water level, extraction rates, and water quality.
2) We would encourage DWR to consider implementing more realistic data processing, visualization and sustainable resource management technologies we've developed that complement simulations while ensuring immediate response to unsustainable conditions related to groundwater extraction in many parts of California.
3) We would encourage DWR to also consider requiring use of these new sustainable resource management technologies whenever well permit applications are submitted for evaluation.

Additional details are provided below:

1. It is impossible to manage what is not measured. As such, we are strong advocates for real-time continuous monitoring of water level, extraction rates, and water quality.

We firmly believe that without proper information, DWR will not be able to achieve its formidable mission regarding sustainable management of groundwater. Basin overdraft, seawater intrusion, stream depletion, land subsidence, water-quality degradation, and other economic and environmental challenges cannot be properly addressed unless we clearly understand the current status of each critical basin, impacts associated with extraction schedules and rates, and dynamics associated with climatic conditions and other natural and anthropogenic processes. Costs for water level sensors, meters, and water quality (e.g., conductivity/salinity) sensors have come down significantly over the past decade. In addition, automated data processing, visualization and response capabilities are now available to help resolve challenges associated with managing the types of data required to appropriately and rapidly respond to unsustainable groundwater extraction activities.

2. **We would encourage DWR to consider implementing more realistic data processing, visualization and sustainable resource management technologies we've developed that complement simulations while ensuring immediate response to unsustainable conditions.**

Our team has developed extremely efficient and cost-effective award-winning Cloud based software solutions that can be leveraged to streamline the management requirements associated with meeting key groundwater sustainability objectives. For instance, we've developed software that allows practitioners to observe the spatial distribution of groundwater levels in near real-time. We map water level sensor data through a convenient web dashboard, accessible through any browser supported device. In addition, by implementing our Groundwater Basin Storage Tracking (GBST) platform, users can estimate changes in aquifer storage between any two selected time steps within a matter of seconds (versus traditional methods that require months or longer). This can also be used to estimate the current amount of available water in an aquifer at any time, which would enable resource managers the ability to know how close to sustainable yield the basin is at all times. This is an intuitive platform that does not require significant training, and therefore, this platform can be accessed by all decision-makers involved in a transparent resource management process.

Our team has also developed a Water Sustainability Platform (WSP), which integrates level sensors, extraction well meters, and key algorithms that incorporate classical hydrogeological theory and game theory to determine maximum sustainable extraction rates from any well within a network. This is used to protect from basin overdraft, seawater intrusion, and stream depletion. System dynamics are automatically adjusted for in real-time. In fact, if it is determined that a well or set of wells are resulting in unsustainable conditions, controllers can be automatically engaged to reduce extractions in select portions of aquifers.

These technologies described above can also serve to help calibrate simulations that are not necessarily designed to answer key questions required for sustainable resource management. For instance, stream flows are not easy to simulate or predict using numerical models such as Modflow, and as such, understanding sustainable groundwater extraction rates that would maintain safe discharges is virtually impossible using traditional approaches.

3. We would encourage DWR to also consider requiring use of these new sustainable resource management technologies whenever well permit applications are submitted for evaluation.

We are encountering many instances where groundwater extraction well permitting agencies are not applying pragmatic criteria when evaluating permit applications. This has resulted in overdraft, stream depletion, seawater intrusion, long-term degradation of local groundwater resources and riparian habitat impairment. We are convinced that by adopting the WSP briefly described above, permitting agencies will be able to vet applications against aquifer-specific criteria before issuing permits. For instance, if one knows the location, screen depth range, and intended extraction rate for a candidate well installation, provided there is an understanding of transmissivity for that location and depth range, it will be possible to predict the impacts this prospective well will have on adjacent wells and the aquifer as a whole. Without this type of process in place, it will be extremely difficult to meet sustainability objectives.

We greatly appreciate this opportunity to share our thoughts. In addition, we would like to work with you to field a demonstration of these technologies. As such, we would greatly appreciate an introduction to the appropriate DWR representative so that we can discuss this in greater detail.

Kindest Regards,

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Dr. Mark Kram is the Founder and CTO for Groundswell Technologies, Inc., a group specializing in automated Cloud based monitoring and modeling of environmental sensor and analytical instrumentation networks. Dr. Kram earned his Ph.D. in Environmental Science and Management from the University of California at Santa Barbara, an M.S. degree in Geology from San Diego State University, and his B.S. degree in Chemistry from the University of California at Santa Barbara. He has over 30 years of experience using innovative environmental assessment techniques, has authored articles, national standards and book chapters on the subject, has taught graduate level courses on related topics and serves as an expert witness on high-profile environmental court cases. Dr. Kram is an internationally recognized expert in site characterization and remediation, and has been instrumental in the areas of sensor development and implementation, innovative GIS applications, DNAPL site characterization, chemical field screening, well design, mass flux/discharge based remediation performance, and groundwater basin yield and storage change assessment. Dr. Kram has patented inventions for automated sensor based contouring and multivariate analyses, automatic determination of groundwater basin storage change, water sustainability to protect from basin overdraft, seawater intrusion and stream depletion, and for in-situ measurement of groundwater contaminant flow rates and directions. Dr. Kram has been featured in Forbes (http://www.forbes.com/sites/michaeltobias/2012/01/31/environmental-security-sensing- the- world-in-4-d/), is an active member of the National Ground Water Association (NGWA), American Society of Testing and Materials (ASTM Subcommittees D18.21 and E50.02), and the Interstate Technology Regulatory Council (ITRC), and is currently preparing national guidance for vapor intrusion and environmental characterization applications. Dr. Kram recently co-chaired an ASTM International symposium on continuous soil vapor chemical measurements, served as Editor for the ASTM International book entitled "*Continuous Soil Gas Measurement: Worst Case Risk Parameters*" (http://www.astm.org/BOOKSTORE/PUBS/STP1570.htm), is the recipient of the NGWA's prestigious Technology Award (http://www.ngwa.org/Media- Center/press/2011/Pages/Kram-wins-2011-Technology-Award-from-the-National- Ground- Water-Association2.aspx), and received the 2014 ASTM Committee D18 Technical Editors Award.

Dr. Hugo A. Loaiciga, Ph.D., P.E., is a groundwater hydrologist with 30 years of professional experience in the field of groundwater hydrology. He has been a professor with the University at California at Santa Barbara since 1988. He has been a hydrologic consultant in several states, and has published 230 scientific and technical publications in the field of hydrology. His CV is available at http://www.geog.ucsb.edu/~hugo